Pennsylvania Fisher Reintroduction Project[a]

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Abstract: Fishers (*Martes pennanti*) disappeared from Pennsylvania during the early 1900s because of extensive timber harvest and unregulated trapping. To restore fisher populations to northern Pennsylvania, we partnered with university researchers to initiate a fisher reintroduction project in 1994. Dr. Thomas L. Serfass of Penn State University/Frostburg State University headed the fisher reintroduction effort. Dr. Serfass and his research team evaluated habitat conditions to select appropriate release sites, conducted public information campaigns to gain support for the project, applied principles of conservation genetics in selecting sources of fishers, and held fishers captive for a 10-14 day veterinary evaluation to ensure released individuals were healthy and well-conditioned. During 1994-98, 190 fishers were released among five sites in northern Pennsylvania. Initial radio-telemetry studies conducted at three of the reintroduction sites indicated relatively high first year survival and a tendency of individuals to remain in the general vicinity of release areas. Subsequent track-plate surveys, snow-track surveys, remote camera surveillance, highway mortality carcass examination, sighting and sign reports, and accidental captures during trapping seasons indicated fishers were persisting at all reintroduction sites. Although this investigation suggests that reintroduced fishers are likely to establish self-sustaining populations, long-term monitoring is recommended to verify continued fisher population sustainability and range expansion.

Dr. Thomas L. Serfass from Frostburg State University prepared a final fisher reintroduction report for this research project. His document, entitled *Fisher Reintroduction in Pennsylvania*, represents the final project report (Serfass et al. 2001). A copy of this reintroduction report will be placed in the Pennsylvania Game Commission (PGC) Bureau of Wildlife Management's final research report file. The following is a synopsis of portions of that report directly pertaining to fisher reintroduction in Pennsylvania.

Fishers (*Martes pennanti*) were once widespread in forested regions of Pennsylvania (Genoways and Brenner 1985). Although occasional reports of fisher sightings persist, viable populations were eliminated from the Commonwealth by 1900. A fisher trapped in Clinton County in 1901 and another trapped in Lancaster County in 1921 are the only documented cases of fishers occurring in Pennsylvania during the early 1900s (Hagmeier 1956).

Loss of forested habitat and unregulated harvest were the most important factors contributing to the decline of fisher populations in Pennsylvania and throughout the United States (Powell 1993). Populations in the Pacific northwest remain threatened because of extensive timber harvest. However, modern timber management practices in the Great Lakes states and New England have facilitated the recovery of fisher populations to harvestable levels.

Improved wildlife and forest management techniques have enabled wildlife agencies in other states to successfully reestablish fisher populations (Weckwerth and Wright 1968, Brander and Books 1973, Berg 1982). For example, fishers were successfully reintroduced into southeastern New York and West Virginia (Pack and Cromer 1981, Wallace and Henry 1985). Because of modern forestry practices implemented by the Bureau of Forestry, industry, and private landowners, Pennsylvania again supports large expanses of forested habitats. Consequently, there is potential to reestablish fisher populations to portions of the Commonwealth. Based on successful fisher reintroductions in surrounding states and improved habitat conditions, we are convinced that our restoration efforts will result in fisher populations being restored to portions of their former range in Pennsylvania.

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[a]Final report for Project 06680, Job 68001, July 2001

The foremost purpose for initiating the fisher reintroduction project was to restore a component of Pennsylvania's wildlife heritage to provide outdoor enthusiasts the potential to view one of North America's rarest and most interesting furbearers. We believe this fisher reintroduction effort will establish a solid foundation for realizing this objective.

PROCEDURES

To update the status of fishers, we conducted a questionnaire survey of Wildlife Conservation Officers (WCOs) throughout Pennsylvania during April 1994. Although five WCOs received second-hand reports of fishers in their districts within the five years previous to our survey, survey results indicated no direct evidence of fisher populations occurring in the Commonwealth. Because of the fisher's vulnerability to trapping, the existence of an established population is unlikely without the occurrence of incidental captures during trapping seasons for fox, coyote, and raccoons.

We based selection of potential reintroduction sites on a literature review of fisher habitat requirements and interviews with biologists that have coordinated fisher reintroduction projects. Primary concerns were selecting sites comprised of extensive forest cover, large tracts of public lands, low human population densities, and an adequate prey base. Public lands were considered an essential component of proposed reintroduction sites, because the long-term integrity of these habitats would not be threatened by development.

A geographic information systems (GIS) was used to identify three important components of fisher habitat: 1) forested regions, 2) public lands, and 3) areas of low human population density. The intersections of these habitat components were regions most suited for establishment and long-term maintenance of fisher populations. Based on GIS results, three regions were identified as potential fisher reintroduction areas: 1) Allegheny National Forest (ANF), 2) State Forest, State Park, and State Game Lands in northcentral Pennsylvania, and 3) State Game Lands in Sullivan and Wyoming Counties. The largest land area comprising the three critical habitat components occurred in northcentral Pennsylvania, covering approximately 3,390 km^2 (1,308 mi^2). Consequently, initial reintroduction efforts focused on northcentral Pennsylvania. Exact release areas were based on investigations to determine age of forest stands, densities of important fisher prey items, and trapping pressure.

Ideally, reintroduction projects should attempt to obtain most founding individuals from the nearest viable populations (Meffe 1987). Founders, from nearby populations, have evolved under selective pressures induced by the range of environmental conditions in the region and, as such, should be the best suited to adapt to conditions imposed at release sites.

New York and New Hampshire support the nearest fisher populations of adequate sizes to sustain a reintroduction project. Both states support fisher trapping seasons. Directors of the New York Department of Environmental Conservation and the New Hampshire Fish and Game Department agreed to cooperate with the PGC in obtaining fishers for translocation to Pennsylvania. We obtained fishers through purchases from trappers in New York and New Hampshire and transported them to Pennsylvania with cooperation from furbearer biologists in the respective agencies.

Release of 23–43 fishers was sufficient to establish populations in Idaho, Montana, southeastern New York, and West Virginia. Based on success of these programs, we planned to release 25–40 fishers per reintroduction site. Leberg (1990) applied population genetics principles developed by Wright (1969) to demonstrate that loss of heterozygosity in founding populations is small if the population consists of 10 or more individuals of equal sex ratios. Consequently, the number of fishers released in Pennsylvania was sufficient to retain genetic diversity and thereby maintain long-term viability of the reintroduced population and avoid deleterious effects of inbreeding (Serfass 1994). Release of fishers

from two discrete populations (New York and New Hampshire) minimized potential for inbreeding and associated deleterious effects by reducing the likelihood of releasing a large number of related individuals. In addition, we located release areas such that each reintroduced subpopulation would be able to interact with other subpopulations within a minimal number of years, further enhancing heterozygosity within the overall statewide population.

We conducted radio-telemetry studies primarily at three of the reintroduction areas: Fish Dam Wild Area, Sullivan/Wyoming Counties, and ANF. The primary purpose of telemetry studies was to document presence and survival at reintroduction sites. We used telemetry receivers, antennas, collars and transmitters (MOD-080) manufactured by Telonics Telemetry Consultants (932 E. Impala Avenue, Mesa, Arizona, 85204-6699). Most telemetry locations were obtained by ground travel. However, when appropriate, we used airplanes to locate missing fishers.

Population Monitoring

We attempted to develop and refine methods to detect fishers in and around reintroduction areas. These survey methods will be useful for future monitoring of population trends and range expansion. Survey techniques were based on snow tracking, track plate, and photographic station methods already in use in North America for fishers and other carnivores. Initial snow tracking surveys were conducted from January–March 1997–99. Track plate surveys were conducted from September–May 1998–99. Remote camera surveys were conducted from January–May 1998–99.

Track plate and snow tracking surveys have been conducted near previous fisher release sites in northcentral and northeastern Pennsylvania. Survey areas included parts of Elk, Moshannon, Sproul, Tiadaghton, and Tioga State Forests in Cameron, Centre, Clinton, Clearfield, Lycoming, Potter, and Tioga counties as well as State Game Lands in Sullivan and Wyoming counties. Photographic surveys were conducted in both northcentral (Clinton and Clearfield Counties) and northwestern (ANF, Elk County) Pennsylvania.

Sooted Track Plate Surveys

Aluminum plates, 20.3 x 76.2 x 0.1 cm (8” x 30”), were sooted with an acetylene torch and partially covered with white contact paper. Track plate stations were baited with raw chicken, fish, or venison and inserted in open-ended, collapsible wooden boxes. Boxes were placed approximately 0.8–3.2 km (0.5–2.0 mi) apart within 200 m of roads at locations considered good fisher habitat. Various attractants including fisher, skunk, and long distance call lures and shellfish oil were placed on cotton balls in film canisters within 3.0 m of boxes to supplement bait. For each track plate station we collected habitat data including elevation, aspect, dominant vegetation type, Anderson Land Use code, percent deciduous trees in canopy, mean overstory tree diameter, percent canopy closure, and distance to various edges. Track plate locations were plotted on 1:24,000 USGS 7.5” topographic quadrangles, and UTM coordinates determined for future use.

Track plates were visited at intervals varying from 1–15 days for periods of 10–44 days. During regular visits, track plate stations were rebaited and plates replaced as necessary. Data collected during each visit included visit number, nights since last visit, weather since last visit, and tracks of interest.

Track plate surveys have been completed in September–May of 1997–99 within the following four previous fisher release areas: Elk, Moshannon, and Sproul State Forests (mostly within Quehanna Wild Area), southern Sproul State Forest (1997–99), Sullivan and Wyoming counties (October 1997), and Tioga and Tiadaghton State Forests (January–May 1998).

Snow-Tracking Surveys

We conducted snow tracking surveys from January–March 1997–99. Surveys were usually conducted within four days after snowfall and before significant thawing could alter tracks. However, weather conditions required that some surveys be conducted under conditions when snow-pack was old, but warming daytime temperatures allowed fresh tracks to register. Only trained personnel performed snow-tracking surveys to ensure positive identification of fisher tracks. Snow tracking surveys were distributed such that each survey area was likely to detect a different fisher. All survey areas included multiple habitat types, however, each contained some high quality fisher habitat.

Snow tracking surveys were conducted using various methods. Prior to beginning surveys, study areas were divided into 10.24 km^2 (4 mi^2) sampling units. Some surveys were conducted within these sample units, however, snow conditions (too much or too little snow) or lack of suitable roads often made surveys using pre-determined sampling units inefficient. Consequently, we conducted many surveys by simply driving or walking suitable roads, trails, or streams.

Surveys were conducted by driving all passable roads with suitable snow cover, excluding major highways, and by walking hiking trails and stream valleys and visually searching for fisher tracks. Locations of fisher tracks were plotted on 1:24,000 USGS 7.5" topographic maps. We recorded the same habitat information for each set of tracks as was recorded at track-plate stations. Surveys by vehicle continued as long as habitat and snow conditions in the area were suitable. Surveys conducted by walking were frequently terminated as soon as fisher tracks were found, allowing us to cover areas as efficiently as possible.

Photographic Bait Station Surveys

We were able to keep radio-telemetry contact with one of four female fishers from our initial releases in the ANF in winter 1996–97, until her transmitter went off the air in mid-November 1997. One single-sensor 35mm camera system (Trailmaster TM1500) was constructed within her home range in an attempt to document continued survival and natural reproduction. A wire mesh basket was secured to a tree out of reach of canids and baited with various meats and skunk lure. A Trailmaster camera was aligned in such a manner as to photograph only fisher-sized animals clinging to the bait tree. This camera station was visited periodically from January–May 1998. Bait, lure, batteries, and film were replaced as necessary.

During January–March 1999, one single-sensor 35mm camera system (Trailmaster TM1500) was constructed within Quehanna Wild Area (Moshannon State Forest). A setup very similar to that used in ANF was used and the camera was visited approximately once per week.

Fisher Sightings

We compiled reports of fisher sightings and included data from surveys for the entire period 1995–99, to document the current fisher range in Pennsylvania. Locations of sightings were plotted on 1:24,000 7.5" USGS topographic quadrangles and UTM coordinates were determined. Data recorded in sightings files included date of observation, observers name and telephone number or address if available, county, topographic quadrangle, UTM coordinates, and a brief description of the sighting.

RESULTS

Fisher Releases and Radio Telemetry

Fish Dam Wild Area

Fish Dam Wild Area was the first fisher reintroduction site in Pennsylvania. Twenty-five fishers (12M,13F) were released in the area during 19 December 1994–27 January 1995 (Table 1). The Wild Area lies within the 113,030-ha (279,636-ac) Sproul State Forest. Sproul State Forest, located in Centre and Clinton Counties, contains some of the most rugged and remote forested areas in the state, composed primarily of mixed oak, with a component of northern hardwood in the northern section. Forest types in the Fish Dam Wild Area are comprised of a combination of mixed oak and northern hardwoods interspersed with white pine (*Pinus strobus*) and eastern hemlock (*Tsuga canadensis*).

We equipped 15 fishers (8M,7F) with radio-transmitter during initial releases at the Fish Dam Wild Area, which took place during December 1994-January 1995. Results of radio tracking at this site were generally discouraging. Among the seven females monitored, six slipped their collars within six months of their release (Table 2). Most collars were retrieved in cavities associated with den trees or at the base of potential den trees. We suspect loss of collars was related to the following possible factors: over caution by researchers in tightening the collars; applying the collars late in the captive management program, after fishers had gained considerable weight (post-release return to pre-captive weights likely caused collars to become lose); use of small cavities which may have served to remove collars when fishers moved their heads in and out of the cavity. Monitoring periods of females ranged from approximately 3-6 months (Table 2). The final location (including location of slipped collars) for each female fisher monitored was within 30 km of the release location. Only 1 male fisher was known to have slipped its collar. Ratios between head and neck circumferences were considerably larger in males than in females and may have accounted for the differences in slipped collar frequency.

Males were extremely difficult to monitor. Within 5 months after release, we had lost contact with four males. Another male was hit by a car (we subsequently euthanized this animal) about 80 km north of the release site, approximately one month after release. We suspect the other missing fishers exhibited similar long-distance movements and were unable to locate them during extensive flights covering most of northcentral Pennsylvania. The two male fishers that we continued to radio track traveled extensively and were 50 and 80 km from the release site when last located (Table 2). Based on literature reviews and our experiences, we suspect spring movements observed by male fishers in this study is not unusual and probably is related to dispersal of young males and adults searching for females.

Although having a large number of females slip their collars and losing contact with four males was disappointing, initial information suggested that all fishers could adequately find forage in release areas and that most females remained in the general release area. We are also encouraged by the compilation of well-documented evidence demonstrating that fishers persisted in the Fish Dam Wild Area and surrounding forested habitats.

Table 1. Release sites, sexes, and numbers of fishers released in Pennsylvania, 1994–98.

Release Site	Date	Males	Females	Unknown	Total
Fish Dam Wild Area					
	19 Dec 1994	3	3	0	6
	23 Dec 1994	5	4	0	9
	29 Dec 1994	3	4	0	7
	27 Jan 1995	1	2	0	3
	Total	12	13	0	25
Quehanna Wild Area					
	26 Jan 1995	0	4	0	4
	30 Jan 1995	3	1	0	4
	9 Mar 1995	2	5	0	7
	12 May 1995	1	2	0	3
	25 May 1995	0	1	0	1
	13 Nov 1995	3	1	0	4
	Total	9	14	0	23
Pine Creek Valley					
	22 Nov 1995	5	5	0	10
	5 Dec 1995	3	1	0	4
	11 Dec 1995	3	2	0	5
	12 Dec 1995	2	3	0	5
	14 Dec 1995	2	6	0	8
	21 Jun 1996	0	1	0	1
	8 Jul 1996	0	1	3	4
	Total	15	19	3	37
Sullivan/Wyoming Counties					
	18 Dec 1995	5	8	0	13
	19 Feb 1996	0	2	0	2
	21 Feb 1996	1	2	0	3
	23 Feb 1996	3	7	0	9
	4 Mar 1996	3	3	0	6
	14 Mar 1996	3	3	0	6
	Total	15	25	0	40
Allegheny National Forest					
	11 Dec 1996	5	2	0	7
	19 Dec 1996	14	5	0	19
	Unknown 1996	0	1	0	1
	29 Jan 1997	8	0	0	8
	26 Feb 1997	0	4	0	4
	22 Dec 1997	1	8	0	9
	21 Jan 1998	2	1	0	3
	4 Feb 1998	1	1	0	2
	10 Feb 1998	2	2	0	4
	9 Apr 1998	3	1	0	4
	Total	36	25	0	61
Kettle Creek					
	18 Jun 1998	0	1	3	4
Statewide Total		87	97	6	190

Table 2. Summary of radio-tracking results for 15 fishers (8M, 7F) released at Fish Dam Wild Area in northcentral Pennsylvania, 1994-95.

Ear Tag Numbers	Sex	Date Released	Date last located	Approx. distance and direction from release site to last location	Comments
08-25	M	12/29/94	05/04/95	8 km, E	Lost contact
96-77	M	01/27/95	03/05/95	80 km, N	Hit by car; Euthanized
14-07	M	12/19/94	04/11/95	1 km, S	Slipped collar
34-21	M	12/23/94	05/09/95	50 km, N	Lost contact
66-67	F	01/27/95	05/12/95	8 km, E	Slipped collar in tree cavity
54-51	F	12/22/94	03/23/95	30 km, E	Accidentally caught by trapper in set intended for raccoons
46-13	M	12/20/94	05/09/95	40 km, N	Lost contact
24-71	F	1/27/95	04/27/95	6 km, W	Slipped collar
90-95	F	12/23/94	05/12/95	15 km, E	Slipped collar, retrieved from cavity in white pine
18-09	M	12/19/94	10/22/95	50 km, W/SW	Ceased monitoring
14-85	F	12/23/94	04/18/95	10 km, W/SW	Slipped collar at base of possible den tree near mouth of Moores Run
11-02	F	12/19/94	04/12/95	14 km, N/NW	Slipped collar at base of tree in Cooks Run
22-03	F	12/19/94	06/15/95	10 km, E	Slipped collar
84-89	M	12/23/94	07/95	60 km, E	Ceased monitoring
86-55	M	12/22/94	02/21/95	5 km, E	Lost contact

Quehanna Wild Area

The Quehanna Wild Area served as the second reintroduction site in Pennsylvania. The area received 23 fishers (9M,14F) during 26 January–13 November 1995 (Table 1). These fishers were released in or near the Wykoff Run valley in southern Cameron County. The Quehanna Wild Area is located within parts of both Elk and Moshannon State Forests, which together encompass approximately 155,093 ha (383,700 ac). Individually, the Wild Area preserves 20,200 ha (50,000 ac, composed mostly of mixed-oak forest interspersed with stands of northern hardwood and mixed coniferous/hardwood forest) of relatively undisturbed forested habitat.

Pine Creek Valley

Pine Creek Valley received 38 fishers (16M,19F,3 unknown) during 22 November 1995–8 July 1996 (Table 1). Fisher releases took place in three separate areas, with Naval Run and Algerine Swamp receiving the majority of fishers. We released a wild-caught female and her three captive-born young (sexes undetermined) near Colton Point State Park, in the Tioga State Forest.

Pine Creek is the largest tributary to the West Branch of the Susquehanna River. The Pine Creek valley lies largely within the 86,890-ha (214,970-ac) Tiadaghton State Forest in Lycoming and Tioga Counties. The Tiadaghton State Forest covers 333,033 ha (824,000 ac), of which 83% is forested. Northern Hardwood forests dominate the landscape of the Pine Creek Valley. However, numerous large tracts of mixed and coniferous forest, as well as many pine and spruce plantations provide excellent habitat for fishers. Numerous wild areas and natural areas comprise portions of Tiadaghton State Forest, including Algerine Swamp Natural Area, a unique 34-ha (84-ac) area containing a sphagnum bog surrounded by tamarack (*Larex laricina*), black spruce (*Picea mariana*), and balsam fir (*Abies balsamea*).

Sullivan and Wyoming Counties

Thirty-nine fishers (14M,25F) were released in Sullivan and Wyoming counties during 18 December 1995–14 March 1996 (Table 1). Fishers were released among three contiguous State Game Lands, which are managed by the PGC. The gamelands comprise approximately 61,000 ha (150,000 ac) of mostly forested habitat interspersed with early successional patches maintained by the Game Commission to benefit wildlife that feed in early successional habitats. The gamelands are near the Wyoming State Forest and Ricketts Glen State Park. The park is comprised of about 5,283 ha (13,050 ac) in Luzerne, Sullivan and Columbia counties. The park includes old growth stands of white pine and eastern hemlock, which contain trees over 500 years old.

We used radio-telemetry to monitor the fates of 8 fishers (2M,6F) released on State Game Lands in Sullivan and Wyoming counties during February 1996. Our intent was to determine if fishers remained in the vicinity of release sites and evaluate survival by monitoring the fishers for about one year following their reintroduction. None of the fishers slipped their collars during this period of radio tracking. We lost contact with 2 of the fishers within 4 months of their release, but maintained radio contact with the other fishers for 1 year (Table 3). The number of radio locations obtained from these fishers ranged from 6-16. All of the fishers occupied areas (defined by home range estimates, Table 3) within 30 km of the study area. We were pleased with the site fidelity and high survival among fishers reintroduced in this area. More recent evidence based on reported sightings, accidental captures (and release) of fishers by trappers pursuing legal furbearers, and snow track surveys demonstrate that fishers persist in this area.

Allegheny National Forest

Between 11 December 1996 and 9 April 1998, 61 fishers (36M:25F) were released among six sites centrally located in the ANF (Table 1). The ANF is Pennsylvania's only National Forest, occupying more than 207,360 ha (513,000 ac) of the Allegheny Plateau in portions of Elk, Forest, McKean, and Warren counties in northwestern Pennsylvania. Forests in the ANF are composed mainly of northern hardwood and mixed forests. Many areas have been set aside to preserve the undeveloped nature of the forest environment. Among these areas are the Tionesta Scenic Area and the Tionesta Natural Area, which encompass more than 2,020 ha (5,000 ac) of virgin forest. Hickory Creek Wilderness Area includes 3,464 ha (8,570 ac) of protected wilderness.

Table 3. Home range estimates for fishers released in Sullivan and Wyoming counties, northwestern Pennsylvania, 1996-97.

Ear Tag Numbers	Sex	Age Class	Date of First Location	Date of Last Location	Number of Locations	Home Range Estimates: Adaptive Kernel (ha)	Home Range Estimates: Harmonic Mean (ha)	Home Range Estimates: Minimum Convex Polygon (ha)
186(R) 277	M	Adult	2/24/96	1/23/97	8	62,330	3,846	26,820
258(R) 195	F	Adult	2/24/96	1/28/97	12	17,520	2,685	5,536
134(R) 223	M	Adult	2/23/96	8/8/96	6	6,761	106	2,713
264(R) 203	F	Juvenile	2/22/96	1/27/97	16	10,810	3,877	4,860
172(R) 231	F	Adult	2/24/96	1/8/97	6	7,000	961	1,980
236(R) 193	F	Adult	2/24/96	1/8/97	13	770	104	357
030(R) 123	F	Adult	2/24/96	1/27/97	16	1,960	2,426	4,865
288(R) 247	F	Adult	2/22/96	3/20/96	6	Slipped collar less than 30 days after release		

From February 1997-January 1999, we monitored survival, home range development, and habitat use. Initially, four female fishers released in February 1997 were the focus of telemetry monitoring (Table 4). Among these fishers, two slipped their collars within 3 months of their release. Another died about five months after being released, and the remaining fisher was monitored for about 10 months. The last fisher was photographed at a remote camera station approximately 14 months after her release in the area she occupied during radio monitoring. The other 11 (1M,10F) fishers included in the telemetry study were released during December 1997 and January-February 1998. These fishers were monitored from periods ranging 1-12 months with 10 of the fishers monitored for at least five months (Table 4). Among these 10 fishers, all established regular areas of use (Table 4) within or near the ANF.

Kettle Creek Valley

On 18 June 1998, we released a female fisher and her 3 captive-born young in the Kettle Creek Valley, Clinton County (Table 1). This area is approximately 30 km north of the Fish Dam Wild Area release area and contains similar habitat features. We selected this site to avoid territorial conflict with the establishing fisher population in the Fish Dam Wild Area.

Table 4. Home range estimates for fishers reintroduced in the Allegheny National Forest, northwestern Pennsylvania, 1997-99.

Ear Tag Numbers	Sex	Age Class	Date of First Location	Date of Last Location	Number of Locations	Home Range Estimates: Adaptive Kernel (ha)	Home Range Estimates: Harmonic Mean (ha)	Home Range Estimates: Minimum Convex Polygon (ha)
7326(R) 7321	F	Adult	2/27/97	5/15/97	9	1,344	168	806
7304(R) 7339	F	Adult	2/27/97	7/3/97	14	4,422	630	2,547
-	F	Adult	2/27/97	4/10/97	7	-	16	169
7348(R) 7309	F	Adult	2/27/97	12/23/97	30	4,162	3,721	2,340
-	M	Adult	12/29/97	7/9/98	13	2,531	155	1,839
-	F	Juvenile	12/29/97	11/19/98	32	2,863	1,266	1,768
-	F	Juvenile	12/29/97	7/14/98	18	4,396	2,507	2,856
PAGCA25 (R)	F	Adult	2/5/98	2/18/99	33	3,763	2,495	2,353
-	F	Juvenile	12/29/97	8/19/98	11	592	33,230	220
-	F	-	1/7/98	7/29/98	10	662	13	288
-	F	Juvenile	12/29/97	8/19/98	13	-	15	532
7324(R) 7311	F	Adult	12/29/97	5/12/98	11	-	-	-
-	F	Adult	12/29/97	8/25/98	16	8,795	2,410	4,047
-	F	Juvenile	1/21/98	1/12/99	23	4,291	5,974	1,067
-	F	Juvenile	12/29/97	1/12/99	45	2,803	1,804	1,503

Population Monitoring

Sooted Track-Plates

Sixty-four track plate stations were assembled for a total of 1,152 track plate nights between September 1997 and May 1998. Track plates were distributed as follows: Quehanna Wild Area – 12 track plates (tp), 144 nights; southern Sproul State Forest – 20 tp, 299 nights; Pine Creek area 14 tp, 493 nights; Sullivan/Wyoming counties 18 tp, 216 nights. Fishers were detected four times at three different stations in the Pine Creek area in Stewardson Township, Potter County (1 station) and Brown Township, Lycoming County (2 stations).

In 1998–99, 32 track plate stations were assembled for a total of 651 track plate nights in Quehanna Wild Area and Sproul State Forest. Twenty-seven track plate stations were assembled for 595 track plate nights in Quehanna Wild Area. No fishers were detected. Five track plate stations were set for 56 track plate nights in Sproul State Forest, Clinton County. Two fishers were detected multiple times at two stations.

Snow Tracking

Inconsistent snow cover over much of Pennsylvania during the winter of 1998 severely hindered snow-tracking surveys. Approximately 500 miles of road were traveled, by vehicle, for the sole purpose of track surveys. During these

surveys, snow conditions were less than optimal, making tracks difficult to see or identify. Fisher tracks were observed at four locations in Clinton, Potter, and Tioga counties.

Deep snow cover combined with ice over much of northcentral Pennsylvania during the winter of 1999 made snow-tracking surveys along unimproved roads difficult. Much of the snow tracking had to be completed on foot, resulting in fewer total miles being covered than in 1998. Approximately 241 km (151 mi) of roads, trails, and streams were surveyed for fisher tracks (Table 5). During surveys, snow conditions were often less than optimal, making tracks difficult to see or identify. Twenty-eight sets of tracks from approximately 17 different fishers were observed in Centre, Clinton, Lycoming, Potter, and Tioga counties.

Table 5. Fisher snow-tracking survey results during 6 January-18 March 1999.

Parameter	Driving	Walking	Total
Mi surveyed	96.30	54.70	150.90
Km surveyed	154.00	87.40	241.40
Number of track sets	8.00	20.00	28.00
Probable number of fishers	4.00	13.00	17.00
Tracks/mi surveyed	0.08	0.37	0.19
Tracks/km surveyed	0.05	0.23	0.12
Fishers/mile surveyed	0.04	0.24	0.11
Fishers/km surveyed	0.03	0.15	0.07

Photographic Bait Stations

We were able to document continued survival of a previously radio-collared fisher in ANF. This female fisher visited our camera several times during January–May 1998. During radio tracking of this fisher in April 1997, she was observed with an uncollared male fisher on two separate occasions. Attempts to document natural reproduction, using a remote camera, were unsuccessful.

One camera, operating for approximately 6 weeks in Quehanna Wild Area, failed to document presence of fishers. One of two cameras, assembled at track plate stations in Sproul State Forest, detected a single fisher on multiple occasions. The first photograph of this fisher was taken within 3 days after the camera was operational. A second camera was assembled for approximately 3 weeks at a location where a fisher had previously been detected by both snow tracking and track-plate surveys. This camera malfunctioned and was removed before the fisher returned.

Fisher Sightings

We have compiled over 80 fisher reports, including sightings from various people as well as snow-tracking and radio-telemetry data. Fisher tracks and sightings have occurred in no less than 18 counties encompassing more than 43 USGS 7.5” topographic quadrangles. In addition to those sightings, PGC personnel have confirmed fisher presence in Cambria, Fayette, Somerset, and Westmoreland counties in southwestern Pennsylvania, and have several unconfirmed sightings from Indiana County. Many of these reports are likely a result of colonization of fishers from a previous restoration project in West Virginia.

DISCUSSION

Reintroduced fishers seem to be persisting in northcentral Pennsylvania. Weather conditions (deep snow, freezing, and thawing) hampered snow-tracking surveys during each of the past 3 winters. Future surveys should be extended to include more areas and continue to evaluate all 3 survey methods (snow tracking,

track plates, cameras). Bait station surveys should use formal methodology, after which it is believed they will be reliable survey techniques that are not dependent on snow cover. Future surveys should attempt to quantify habitat types used by fishers during winter. Determining habitat use should in turn result in more efficient and precise fisher survey methods.

Snow tracking seems to be an efficient method when snow conditions permit. Short walks in high-quality habitat (mature coniferous or mixed forest) resulted in much higher detection rates than surveys conducted by driving (Table 5). Standardized survey routes, which are easily accessible from secondary roads, show potential for efficiently monitoring fisher persistence and range expansion in Pennsylvania.

Monitoring fisher distribution and population trends in Pennsylvania will involve conducting annual surveys within suitable fisher habitats throughout the state. Development of standardized survey techniques is critical to their broad-scale application. Such surveys will enable wildlife managers to determine changes in geographic distribution, generate habitat use data, develop various population indices, and evaluate relative densities of fishers among different areas in a given year and within the same area over time.

Several survey methods are currently being used throughout North America (e.g., Zielinski and Kucera 1995), each providing some advantage over others. For instance, snow track surveys can provide relatively inexpensive means of determining fisher distribution over a large geographic area and may provide an index of abundance. Such surveys, however, can only be conducted during winter, are dependent on adequate snow conditions, and may be subject to limitations brought about by changing road conditions. In contrast, track plate and camera surveys can be conducted throughout the year, provide information on distribution, and may provide an index of relative abundance similar to those obtained from scent-station surveys. These scent-station methods tend to be more expensive and labor intensive than snow tracking, and are usually limited to a smaller geographic area. Using all 3 methods to monitor fisher populations and soliciting reports of sightings will result in several means of assessing population trends and distribution, with each method (e.g., snow tracking, track plates, cameras, reported sightings) providing a check on the others.

Snow-Tracking Surveys

Two types of snow-tracking surveys deserve consideration: 1) searching for tracks; and 2) tracking at bait. Because tracking at bait is more comparable to scent-station surveys, it will be discussed with track plate methods.

Surveys for fisher tracks can be conducted in several ways depending on the specific goals of the survey. The two primary goals of fisher surveys were to determine presence and distribution and to obtain an annual index of abundance. Annual presence and distribution surveys are currently being conducted near previous fisher release sites in northern Pennsylvania. Year-to-year variation in the amount and duration of snow cover will continue to provide challenges for monitoring fisher populations using track surveys.

Although surveys designed to document presence and distribution can be somewhat informal, methodology should allow for efficient coverage of as large an area as possible each year. Surveys should be designed to maximize the probability of detecting fishers while minimizing multiple detections of the same individual. The study area of interest should be divided into survey units. Only those units containing suitable fisher habitat should be considered. For example, researchers should not expend valuable time and resources to survey units made up primarily of urban or residential areas or areas having large amounts of early successional habitat. Zielinski and Kucera (1995) recommended using 2 x 2 mile (10.24 km^2) blocks as survey units to standardize methods across North America and allow for comparisons from one area of the continent to another. The survey methods described by Zielinski and Kucera (1995) were meant

to be applicable to multiple species, and therefore, sample units were scaled to cover the entire home range of the smallest species, American marten (*Martes americana*). Considering that martens may someday be restored to Pennsylvania, it seems reasonable to use 10.24 km^2 units as the basis for fisher surveys.

Surveys for presence and distribution should use one or both of the following methods: 1) driving all passable roads with suitable snow conditions in a sampling unit, excluding major highways, and visually searching for tracks; 2) walking pre-determined routes along trails or streams within sampling units.

Each method has advantages and disadvantages. For instance, driving allows researchers to cover relatively large areas, but, road conditions may not be suitable for locating tracks or driving may be hazardous or impossible in many areas. Walking trails and streams limits the size of the area that can be surveyed. My experience is that weather conditions will necessitate the use of both walking and driving. In either case, surveys within each sampling unit should continue until the area is adequately covered. Surveys should be terminated immediately upon locating fisher tracks, and a new survey started in another sampling unit.

Surveys can proceed in many ways including the following: 1) *directionally* (i.e., east to west) from one sampling unit to another, surveying as many sampling units as possible in a single year; 2) *systematically*, surveying the same number of sampling units each year and distributing sampling units evenly across the study area; or 3) *stratified surveys*, based on perceived habitat quality. For example, researchers should survey all units with high quality habitat before proceeding to lesser quality sampling units. For each set of tracks encountered, map location should be determined and habitat type noted. Zielinski and Kucera (1995) provide standard data sheets that would allow data from Pennsylvania to be compared with data throughout North America.

To develop an index of abundance for fishers, formal survey methods should be employed using pre-determined, permanent transects or routes, specific timing (i.e., mid-January to mid-February), and optimal weather conditions (recent snow cover). A minimum distance between tracks along a route should be determined for use as a guideline when counting tracks to minimize the chance of counting an individual fisher more than once. Survey routes should be randomly located within suitable fisher habitat. Length and number of routes should be determined based on careful consideration of the power needed to detect a specified level of change in track numbers or proportion of survey routes with tracks, and available time and money resources. If resources are available, replicate surveys should be conducted to increase sample size and power. Survey routes should be kept short enough to be located largely within suitable fisher habitat and so that tracking conditions vary as little as possible, while being long enough to cross the home range of at least one fisher. For example, for surveys done by vehicle, 10 survey routes of 10 km in length may be adequate. However, 20 routes of 5 km in length may be more sensitive to actual changes in population size. A larger number of 1–2 km routes may be necessary if surveys are conducted by walking.

All survey routes should be similar in terms of road type, and made up primarily of unimproved and improved dirt roads. These smaller, less traveled roads may be more likely to be included within home ranges of individual fishers and less likely to be plowed soon after a snow event. Methods for assessing tracking conditions on individual routes and for providing objective indices for comparing conditions among survey routes have been developed (Van Dyke et al. 1986, Halfpenny et al. 1995) and could be incorporated into any population index method using snow tracking surveys in Pennsylvania.

Data collected in northern Pennsylvania during January–March 1999, suggested that foot surveys might provide more information per unit length than surveys conducted by driving roads (Table 5). Data collected for each survey route should include date, weather and snow conditions, number of individual fisher tracks, and location of each set of individual fisher tracks observed.

Scent-Station Surveys

A variety of options exist for using scent-station methods to survey fisher populations. As with track surveys, the specific survey design will depend on the goal of the surveys (presence and distribution or index of abundance). Scent-station surveys have the advantage of being independent of snow cover and, therefore, can be used any time of year. In addition, scent-station surveys may provide a comparison to snow tracking results if both surveys are conducted before significant changes in fisher numbers occur in a given year. Options for scent-station surveys include: sooted track-plates, camera stations, and tracking at bait. Methods currently in use in Pennsylvania include track plate and remote camera stations.

Track-Plate Surveys

The general methodology for track plate surveys, currently being used throughout North America to survey fishers and other forest carnivores, uses 10.24 km^2 sample units in a similar manner to snow tracking surveys described previously. A minimum of six track plate stations are placed in each sampling unit, with stations located in areas of the most appropriate habitat. Track plate stations should be placed at least 50 m from roads and approximately 0.8 km (0.5 mi) apart in a grid to maximize coverage of each sampling unit. Stations are visited every 2–4 days for a minimum of 2 weeks, or until a fisher is detected within that sampling unit. After 2 weeks or first detection of a fisher, stations are moved to a new survey unit. Approximately 1–2 full days is required to assemble and dismantle stations in each survey unit, depending on weather, topography, and distance traveled to and from survey areas.

Surveys conducted in Pennsylvania in recent years have encountered some difficulty using 10.24 km^2 sampling units. Road densities are often too low or topography too rugged to allow track plate stations to be placed in a grid formation. Consequently, track plate stations have often followed roads in a linear formation, with stations alternating from one side of the road to the other. Stations have been placed 50–200 m from the road at approximately 0.8 km (0.5 mi) intervals in good fisher habitat. It has not been determined whether this method is responsible for lower detection rates compared to snow tracking surveys, but this problem may be offset by the reduced amount of time and labor necessary to construct track plate stations in this manner.

When establishing track plate stations, we recommend taking equipment such as all-weather duct tape, hatchet, plate-carrying boxes, backpack, latex gloves, stakes, clear cellophane tape (wide), camera, paper towels, garbage bags, and anti-bacterial wipes. Careful preparation will greatly facilitate surveys.

To develop an index of abundance for fishers, using track plate surveys, a scent-station survey design similar to those currently in use for other species is recommended. Survey routes should be determined in a manner similar to snow tracking index methods. Number of track plate stations per route will depend on length and number of routes as determined from power analysis and available resources. Track plate stations should be located approximately 0.8 km (0.5 mi) apart to maximize chances of surveying occupied habitat.

Camera Surveys

Camera survey methods described here apply only to presence and distribution surveys. The expense of camera systems, supplies, and film developing may preclude their use in more intensive survey efforts. Recommended procedures for conducting camera surveys follow protocols similar to track plate surveys for determining presence and distribution. In the case of cameras, however, fewer stations are needed per sample unit, because the amount of bait used at each camera station is significantly larger than at track plate stations, and camera stations can be visited less frequently (approx. one visit/wk).

Placing two camera stations per 10.24 km^2 sampling unit, with stations located at least 1.6 km (1 mi) apart in the most appropriate habitat or in areas of unconfirmed sightings should result in efficient determination of fisher presence.

Tracking at Bait Stations

Surveys designed to detect tracks in the snow at bait stations should use methodology similar to that used for camera surveys. Tracking at bait can provide an additional, relatively inexpensive means of determining presence and distribution of fishers and other forest carnivores. Baits, including road-killed deer, fish, other carrion, or a combination can be placed within survey units in areas of highest habitat quality. Baits should be as large as possible and at least 5 kg (Halfpenny et al. 1995). A commercial lure, such as skunk, may help attract fishers. Weekly visits to baits should be made throughout the period of snow cover and especially after a recent snow until a fisher is detected or until 30 days has passed.

RECOMMENDATIONS

We are confident that this fisher reintroduction effort has been successful in providing the foundation for the establishment of viable, expanding fisher populations. Continued efforts are necessary to refine monitoring protocols and wildlife and timber management strategies to ensure long-term survival and expansion of reintroduced fisher populations. We believe that research and management activities should be implemented to further enhance protocols established during initial phases of this project. These future research and management activities should include:

1) monitoring efforts (i.e., track plate surveys and snow track surveys) to document persistence of reintroduced fisher populations.

2) documenting location, habitat, and any other pertinent information associated with capture and release of fishers accidentally caught during trapping seasons for legal furbearers.

3) collecting information related to fishers killed along highways or accidentally by trappers during trapping seasons for legal furbearers (i.e., location, habitat, and carcass evaluation to determine age, health at time of death, and reproductive condition).

4) further development, implementation, and refinement of protocols to facilitate long-term monitoring of the status and distribution of the reintroduced population.

5) live-capturing fishers to determine reproduction and recruitment within reintroduced populations.

6) live-capturing and attaching radio transmitters to individuals from the reintroduced populations to facilitate additional study of habitat use and home range requirements of fishers in Pennsylvania.

LITERATURE CITED

Berg, W. E. 1982. Reintroduction of fisher, pine marten and river otter. Pages 159–173 *in* G. C. Sanderson, editor. Midwest furbearer management. University of Illinois.

Brander, R. B., and D. J. Books. 1973. Return of the fisher. Natural History 82:52–57.

Genoways, H. H., and F. J. Brenner, editors. 1985. Species of special concern in Pennsylvania. Carnegie Museum of Natural History, Pittsburgh,

Pennsylvania. Special publication no. 11.

Hagmeier, E. M. 1956. Distribution of marten and fisher in North America. The Canadian Field-Naturalist 70:149–168.

Halfpenny, J. C., R. W. Thompson, S. C. Morse, T. Holden, and P. Rezendes. 1995. Snow tracking. Pages 91–163 *in* W. J. Zielinski and T. E. Kucera, eds. American marten, fisher, lynx, and wolverine: survey methods for their detection. U.S. Forest Service General Technical Report PSW-GTR-157.

Leberg, P. L. 1990. Genetic considerations in the design of introduction programs. Transactions of the North American Wildlife and Natural Resources Conference 55:609–619.

Meffe, G. K. 1987. Conservation genetics and the management of endangered fishes. Fisheries 11:14–23.

Pack, J. C., and J. I. Cromer. 1981. Reintroduction of fisher in West Virginia. Pages 1431–1442 *in* J. A. Chapman and D. Pursley, editors. Proceedings of the Worldwide Furbearer Conference, 3-11 August 1980, Frostburg, Maryland, Worldwide Furbearer Conference, Inc.

Powell, R. A. 1993. The fisher: life history, ecology, and behavior. University of Minnesota Press, Minneapolis and London.

Serfass, T. L. 1994. Conservation genetics and reintroduction strategies for river otters. Dissertation, The Pennsylvania State University, University Park.

Serfass, T. L., R. P. Brooks, and W. M. Tzilkowski. 2001. Fisher reintroduction in Pennsylvania. Final Project Report, Frostburg University, Maryland. 221pp.

Van Dyke, F. G., R. H. Brocke, and H. G. Shaw. 1986. Use of road track counts as indices of mountain lion presence. Journal of Wildlife Management 50:102–109.

Wallace, K., and R. Henry. 1985. Return of a Catskill native. The Conservationist 40:17–19.

Weckwerth, R. P., and P. L. Wright. 1968. Results of transplanting fishers in Montana. Journal of Wildlife Management 32:977–980.

Wright, P. L. 1969. Delayed implantation in the long-tailed weasel (*Mustela frenata*), the short-tailed weasel (*Mustela cicognani*), and the marten (*Martes americana*). Anatomical Records 83:359–374.

Zielinski, W. J., and T. E. Kucera, editors. 1995. American marten, fisher, lynx, and wolverine: survey methods for their detection. U.S. Forest Service General Technical Report PSW-GTR-157.